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Blake (C. J.)

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PERFORATIONS OF THE MEMBRANA  
TYMPANI.

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CLARENCE J. BLAKE, M. D.,  
BOSTON.

[REPRINT FROM THE] TRANSACTIONS OF THE INTERNATIONAL  
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FORMING, as it does, the boundary between the outer and the middle ear, its outer surface covered by a continuation of the dermoid lining of the external auditory canal, and exposed to the outer air, its inner coat a continuation of the mucous lining of the tympanic cavity, the membrana tympani is liable to participation in the diseases which may affect either of the cavities which it separates, and is also liable to mechanical injury from forces acting from without through the external auditory canal.

Von Tröltsch says: "Three of the most important tissues of the animal system are found in this membrane: integument, mucous membrane, and fibrous tissue; hence pathological changes are very common in this part. Although affections of the membrana tympani are very frequent, exact and unprejudiced observation must show that they seldom occur alone, and uncomplicated with an affection of another part of the ear. The membrana tympani is nourished by the same blood-vessels and nerves that supply the cavity of the tympanum and the auditory canal. It thus really only forms a part of these divisions of the ear. In any affection of the adjacent parts, therefore, the drum-membrane will almost always be involved."

Injuries of the membrana tympani also, says the same author, are quite common, as we would infer from the delicacy

of structure of the membrane and its exposed position.<sup>1</sup> The most frequent of the more serious lesions of the membrana tympani, as may be inferred from its structure and anatomical relations, is perforation. The most frequent cause of perforation, says Politzer, is purulent catarrh of the middle ear.

Perforation as the result of violence may be caused by concussion of the air, the atmospheric pressure causing a sudden excursion of such amplitude as to exceed the natural extensibility of the membrane and rupture it across its whole surface. Several cases of this form of injury are reported by Dr. J. Orne Green, the concussion resulting from the explosion of the gas apparatus of a stereopticon. During the late war, also, such cases were not infrequent among artillerymen in the army, and in sailors on vessels carrying heavy guns in the navy. They occurred generally, however, either where men were peculiarly exposed, or where some affection of the middle ear, such as closure of the Eustachian tube, resulted in a preponderance of atmospheric pressure on the outer surface of the membrane.

Perforations of this sort, as would be expected from the nature of the force which causes them, and the structure of the fibrous coat of the membrana tympani, are usually rents with ragged edges, which readily fall into apposition, and which, provided the injury to the middle ear is not sufficient to set up extended inflammation and consequent discharge, as readily heal. The reconstructive power of the membrana tympani is proverbially great, and it is not uncommon to find such rents, under favorable circumstances, entirely closed within forty-eight hours. Similar ruptures may be caused by atmospheric pressure from within. Mr. Hewetson<sup>2</sup> has reported a case of rupture of the right membrana tympani as the result of a severe attack of vomiting; and it has been my own misfortune to cause a rupture, extending from the upper to the lower border of the membrane, across the posterior segment and parallel to the handle of the malleus, by the use of Politzer's

<sup>1</sup> "Treatise on Diseases of the Ear." Von Tröltsch. Translated and edited by D. B. St. John Roosa, M. D. W. Wood & Co., New York, 1869.

<sup>2</sup> London *Lancet*, September, 1875. "Rupture of the Right Membrana Tympani from a Severe Attack of Vomiting."



air-douche. Mr. Hewetson's treatment consisted in warm syringing, and the use of alkaline and then astringent instillations, the opening healing perfectly in eight days. It had become partially healed in the interval between the occurrence of the accident and the patient's application for treatment, and the removal of a crust revealed an opening which healed as above stated. In the other case, the ear was simply protected by cotton, the patient being warned not to blow his nose for two days—which injunction he would seem to have punctually obeyed, for, on his return at the end of three days, the rupture had entirely healed. The rules for the treatment of these fresh ruptures would be the same which apply to the treatment of a rent elsewhere: to cleanse the edges from any coagula or foreign matters, and to bring them into apposition and keep them so.

The cleansing may be effected by a little jeweler's cotton on the end of a probe dipped in warm water; and, unless blood has flowed into the middle ear, care should be taken to prevent the entrance of fluid into that cavity. Where the edges of the rent do not fall readily into contact, the contact may be effected by alternately inflating the middle ear and pressing upon the membrane with the probe. The edges of the rent once in place, the patient should be cautioned against inflating the ear for at least forty-eight hours; and, for further protection, the external auditory canal may be stopped with cotton-wool, or, if the edges show a tendency to separate, their continued contact may be further insured by the application of a bit of paper as described further on.

Perforations, the result of mechanical injury, vary greatly in extent, in the shape of the opening, and in their position in the membrane. The posterior half of the membrane is the most frequent seat of these lesions, because the attacking force usually comes from in front; and the size and shape of the opening depend on the character of the instrument, the force of the blow, and the degree of resistance offered by the membrane. Wounds of this sort heal less readily than simple ruptures; the injury to the deeper-seated parts is likely to be greater; the destruction of the substance of the membrane is apt to be more extensive, and the edges of the opening are

usually pushed inward and more widely separated. If the foreign body which caused the injury remains in the membrane, it should be carefully removed, the edges of the opening drawn outward by a small hook or bent probe, or forced outward by inflation of the middle ear, cleansed and brought into apposition, and the ear protected as before. Occasional inflation may help to keep the parts in contact; but if by the third or fourth day the opening has not closed, and there are no signs of trouble in the middle ear, the paper dressing may be applied, usually with advantage.

Perforations of the membrana tympani occurring as a complication of disease of the middle ear are of a very different character from those already mentioned. They usually follow an inflammatory process of such duration, that the membrana tympani has itself become implicated, and its tissues have undergone such changes as to render it unable to resist either a sudden pressure from the fluid in the middle ear, or the slower but no less fatal invasion of an ulcerative process. In purulent catarrhal inflammation of the middle ear, which is by far the most frequent cause of perforation, the stages which lead to this result follow each other in an almost invariable order. The inflammation of the mucous membrane lining the tympanic cavity and the Eustachian canal soon closes the latter passage at its narrowest point, and cuts off the natural provision for escape of the fluid which soon begins to fill the middle ear. This mucous or muco-purulent fluid, gradually accumulating, presses the already inflamed membrana tympani outward, subjecting it to a force which still further diminishes its power of resistance by inducing changes in its tissues. Every severe inflammation of the mucous membrane of the middle ear, affecting also the mucous layer of the membrana tympani, produces a softening such as occurs in inflammation of other tissues; this may occur throughout almost the whole of the mucous layer, or may be confined to the point subjected to the greatest degree of pressure. The final cause of the perforation may then be either an infiltration of the tissues of the membrana tympani, the opening at first being minute and then rapidly enlarging, or a suddenly-added pressure such as may be caused



by coughing, sneezing, or blowing the nose, which bursts the already-overburdened membrane, and produces a copious discharge. The openings which occur in this manner approach a circular form, and vary greatly in size and position, according to the severity of the inflammation, the degree of pressure, and the length of time during which the membrana tympani has been exposed to its effects, and the condition of the membrane previous to the attack. So far as the treatment of these perforations is concerned alone, this can only follow the treatment of the original disease; so long as there is sufficient discharge to require a vent into the external auditory canal, the opening will probably remain to fulfill that office. In the majority of cases it would be to the patient's benefit if the opening became closed so soon as it was no longer required for this purpose; but while, as is well known, it is extremely difficult to maintain an artificial opening in the membrana tympani, it is almost as difficult to induce the closure of one which has followed an ulcerative process in the middle ear. The advisability of attempting to favor the closure of such a perforation must depend upon the degree of benefit to the hearing, which itself depends upon the perceptive power remaining to the internal ear and the sound-transmitting power remaining to the structures of the tympanum. If the disease has extended to the labyrinth, there is little justification in making any such attempt, for in time the mucous membrane of the middle ear exposed to the air undergoes such changes as to render it but little liable to injury from the exposure. In many cases where the inner ear is intact, the changes in the membrana tympani and middle ear are of a character to destroy or greatly diminish the vibratile or sound-transmitting power of the membrane and ossicular chain as a whole; but the sound-waves, gaining admission to the tympanic cavity through the perforation, reach the labyrinth with more or less diminished force. Where, however, the ossicula have been left free to transmit sonorous vibrations, and enough of the surface of the membrana tympani remains to receive and vibrate in response to the impact of the sound-waves, the closure of the perforation will usually considerably improve the hearing. When the opening is a sizable one, more than two millime-

tres in diameter, for instance, it is usually necessary that the cicatrix should approach in degree of permanent tension the tension of the membrana tympani itself, otherwise there would be an irregular surface whose varying degree of tension would be accompanied by varying degrees of hearing power. In the natural process of repair the opening becomes closed by a membranous cicatrix, the growth of which occurs from the edges of the perforation, not extending toward the centre as a whole, and so uniting, apparently, but by successive growths from different portions of the edge, so that in the process of closure the opening is continually changing its outline.

Where the disease in the middle ear has subsided and the discharge has ceased, leaving a perforation of the membrana tympani with cicatrized edges, the closure of which would improve the hearing, it is necessary to produce such a degree of irritation as shall stimulate a new growth in order to favor the desired result. Cauterization of the cicatrized edge by various means has been recommended, but according to Gruber this treatment is of no value. That author recommends and practises scarification of the part, and also incisions in the vicinity of the opening. Whatever means may be employed to excite a new growth, the reparative process once started should be allowed to proceed with as little interference as possible. Varying atmospheric pressure, on the outer or inner surface of the cicatrix forming, will tend to extend it irregularly and prevent the attainment of the desired tension. To protect the new growth from disturbances will be to secure the fullest effect of the natural process of repair. In these cases I have found a very simple procedure to be of material assistance, either where scarification has been resorted to to produce the necessary degree of irritation, and to clear away the cicatrix binding the edges of the opening, or where the irritation produced by the application to be described proves to be, as is often the case, sufficient. This procedure consists simply in the application of a disk of paper a little larger than the perforation to be covered. Common writing-paper best answers the purpose, for these reasons: it is easily procured of any desired thickness, and the sizing, usually em-



ployed in finishing the paper, when moistened, is sufficiently viscous to insure the adherence of the paper to the membrana tympani. A disk of this sort may be readily introduced under good illumination by means of a pair of forceps, or, better still, by means of a probe tipped with cotton and dipped in water, the paper adhering to the moistened cotton until it comes in contact with the membrana tympani. Any improvement in hearing which may subsequently result from the cicatricial closure of the perforation is at once appreciable on the application of the paper, which should be firmly pressed into place by a probe tipped with dry cotton. Experience proves that a bit of paper thus applied will remain in position until the opening, if a small one, has become closed, when it will be removed by a natural process, or until some inflammatory process recurring causes sufficient discharge to wash it away; in the latter case, when the inflammation has subsided and the surfaces are again dry and clean, the paper may be reapplied. The paper dressing is serviceable only in a limited proportion of cases, namely, those in which the perforation is a small one, the inflammatory process in the middle ear having subsided and discharge having ceased, and the outer surface of the membrana tympani having returned to its normal condition, or in cases of rupture or mechanical injury where the paper may serve to keep the edges of the wound in apposition.

The advantages of this treatment, which is applicable only to certain cases, as above mentioned, are: that it temporarily supplies the place of the natural closure of the opening in the membrana tympani, immediately improving the hearing in cases in which this result would follow a cicatricial growth; that it is in some cases sufficient in itself to cause the irritation necessary to the promotion of a new growth of tissue; and that in any case it protects the new growth beneath it and assures the undisturbed completion of the process of repair.

One of the more favorable instances of the value of the paper dressing, which may be cited in illustration of its use, was that of a woman twenty-eight years of age, who had a perforation of the right membrana tympani,  $1\frac{1}{2}$  millimetre in diameter, in the anterior inferior segment, the result of a purulent inflammation of the middle ear; the inflammation had subsided and



the discharge ceased six months previously; the tympanic cavity was dry, its mucous membrane healthy, and the membrana tympani but slightly opaque; there were no congested vessels or other signs of a progressing reparative process visible; the hearing for the watch was  $\frac{5}{180}$ . On the 24th of August, 1875, a disk of thin writing-paper, about  $2\frac{1}{2}$  millimetres in diameter, was applied, covering the perforation, and the patient directed not to inflate the middle ear for forty-eight hours; the hearing for the watch increased on application of the paper to  $\frac{30}{180}$ . When next seen on the 18th of October, the hearing for the watch had further increased to  $\frac{35}{180}$ ; an examination of the ear showed the perforation to have become closed by a tense, firm cicatrix, and the piece of paper was discovered on the posterior wall of the auditory canal about half an inch from the meatus, with a thin membrane, formerly a portion of the dermoid coat of the membrana tympani, firmly adhering to it.

The displacement of the paper disks after the closure of the perforation in the cases which have furnished the material for this paper led to a series of observations on the growth of the dermoid coat of the membrana tympani, the results of which will be published later.



